Section 5

List of Contents

1 Information Flow (ADC Compact) 1

2 Main Components of the Digitizer 2

2.1 Overview 2

3 Functional Principle of Image Plate and Cassette 4

4 Main Components of the ADC Compact Digitizer 5

4.1 Cassette Unit 1/2 5
4.2 IP-Transport Unit right (prescan) 6
4.3 Scan Unit 7
4.4 IP-Transport Unit (left) 8
4.5 Erasure Unit (150) 9
4.6 VME-Rack (300) 10
4.7 Power Unit 15
4.8 Rotation Unit (200) 16

5 Machine Cycle 17

5.1 Cassette Input 17
5.2 Clamping the Cassette 17
5.3 Opening the Cassette 18
5.4 Sucking the IP 18
5.5 Taking the IP out of the Cassette and down to the Scan Unit 19
5.6 Rotating the Cassette Units by 180° 19
5.7 Loading the IP in the Scan Unit 20
5.8 Scanning the IP 20
5.9 Stimulate and Scan the IP 21
5.10 Collecting the Light 21
5.11 Unloading the IP from the Scan Unit 22
5.12 Moving the IP upwards / Erasing the IP 23
5.13 Putting the IP back into the Cassette 23
5.14 Cassette Output 24
5.15 Output Buffer 24

6 Optical Path 25

7 Signal- and Data Flow 27

7.1 Signal Flow 27
7.2 Image and Control Data Flow 28
7.3 Partition Map of the Harddisk 29
7.4 FLDXXXXX-directories: 30
7.5 NVE-List 31

1 Information Flow (ADC Compact)

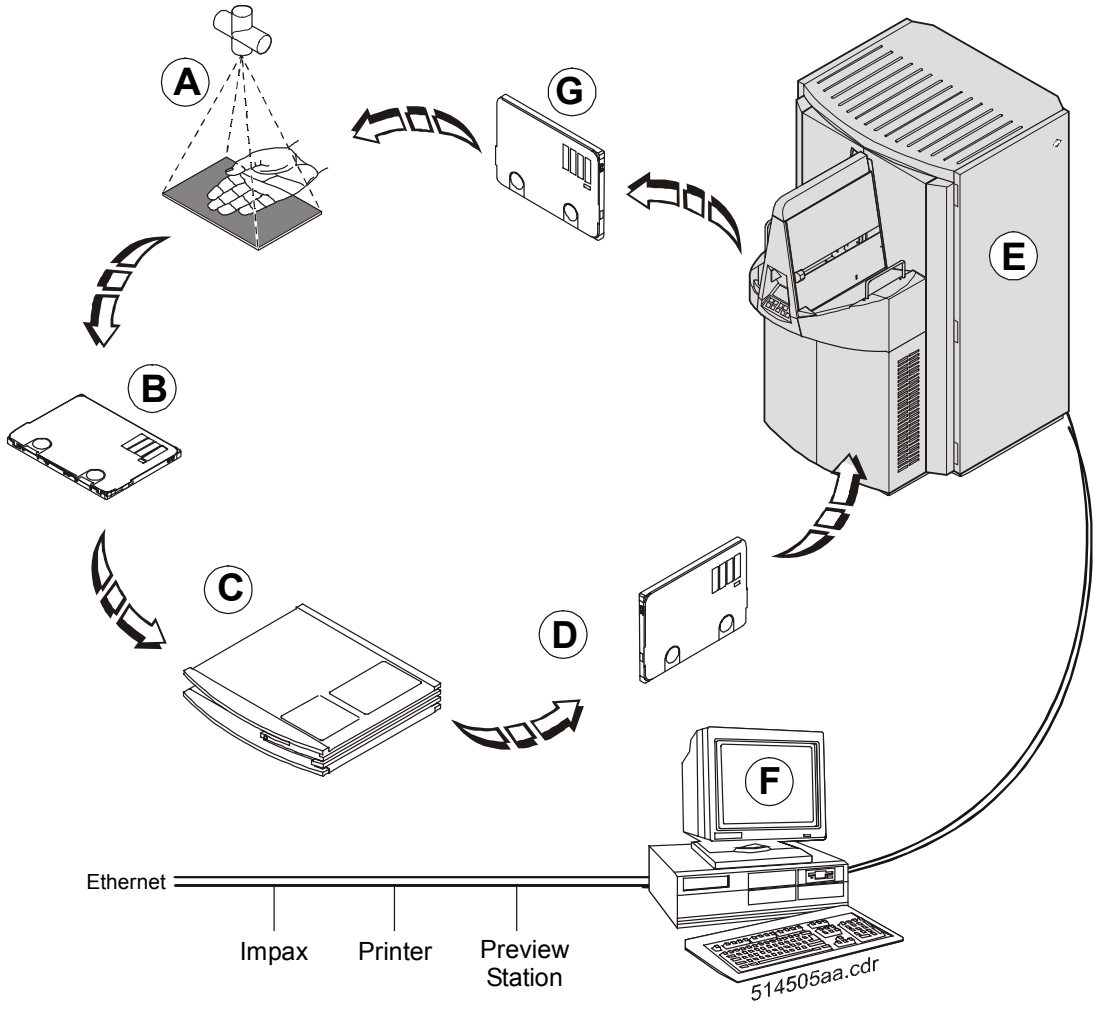


Figure 1

A X-Ray tube:
Exposure of a diagnostic image on the image plate.

B Unidentified cassette with exposed image plate.

C ID-Station:
Input of demographic information (patient data, etc.) into the ID-chip of an exposed cassette via the RF-tag.

D Identified cassette with exposed image plate.

E ADC Compact digitizer:
Conversion of the diagnostic image on the image plate and of the demographic information on the ID-chip into a raw digital image with demographic data.

F Transmission of the raw image to the Processing Station (via DICOM protocol); further image processing on the PS.

G Processed image plates are erased in the digitizer.
The ID-chip is erased by changing the cassette status from „Identified“ to „Erased“.
The erased cassette is given back to the output buffer of the digitizer.

2 Main Components of the Digitizer

2.1 Overview

The digitizer is a scanner for stimulable phosphor plates.
Input: Cassettes and Image Plates (IP) are handled, scanned and erased.
Output: Raw digital images are sent to a processing device via network (DICOM protocol).

The different components of the ADC Compact digitizer:

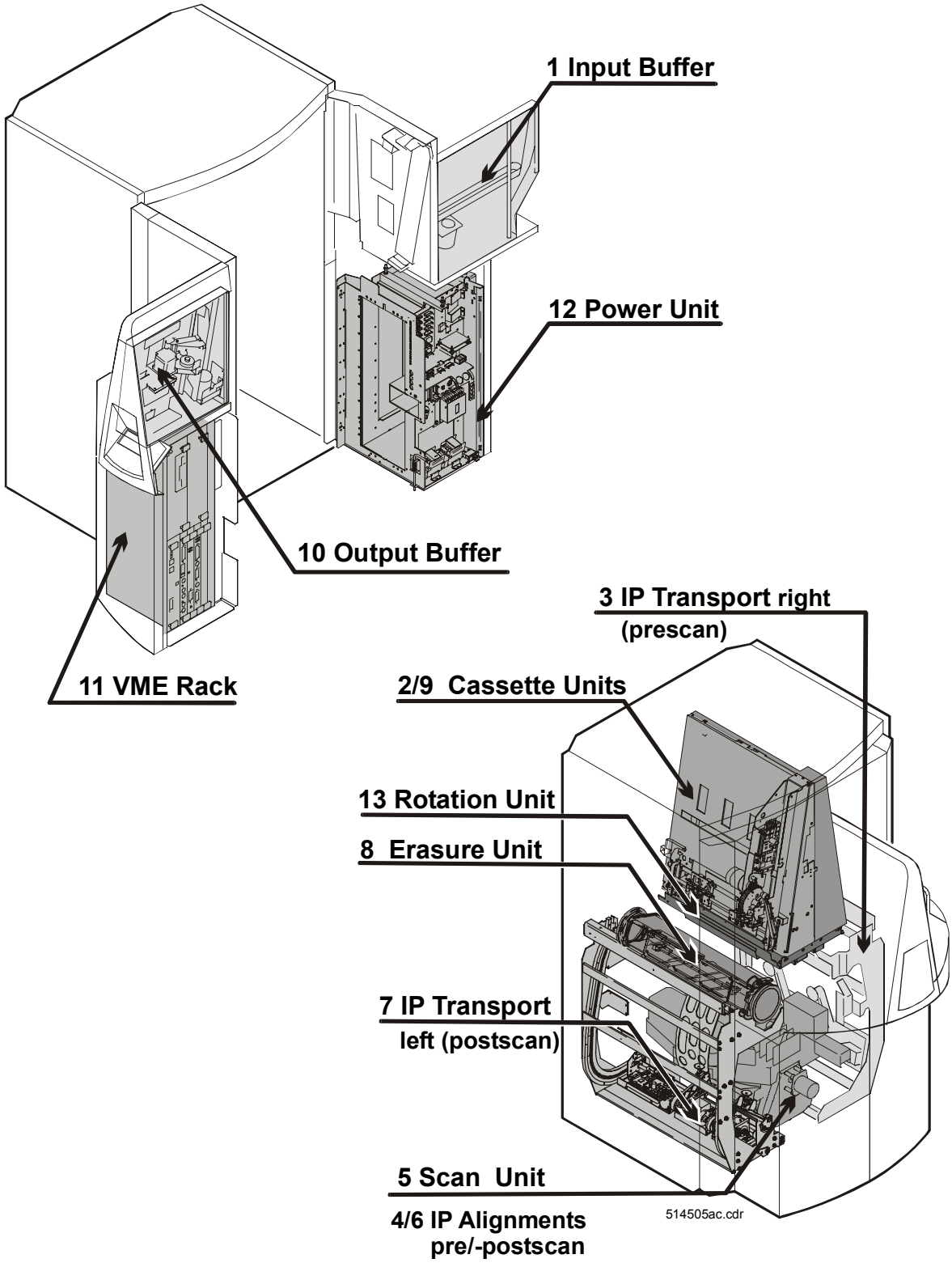


Figure 2

1	**Input Buffer**	• can hold up to ten ADCC cassettes • the R/F-tag reader reads the patient data stored in the chip of the cassette
2	**Cassette Unit 1/2**	• clamps and opens the cassette
3	**IP Transport right (prescan)**	• holds the suction arms and suction cups • takes the IP out of the cassette • transports the IP to the scan unit
4	**IP Alignment (prescan)**	• centres the IP prior to scanning
5	**Scan Unit**	• makes the IP pass the oscillating laser beam at a constant speed • the lens plate holding the optical devices is part of the scan unit
6	**IP Alignment (postscan)**	• positions the IP after scanning relative to the position of the cassette
7	**IP Transport left (postscan)**	• takes the aligned IP and moves it up to the cassette unit, thereby passing the erasure unit. • puts the IP back to the cassette unit
8	**Erasure Unit**	• erases the IP to be ready to be used again
9	**Cassette Unit 1/2**	• provides the open cassette • closes the cassette after IP was put back • transports the cassette to the output buffer
10	**Output Buffer**	• can hold up to ten cassettes • the lever at the output buffer prevents cassette jams
11	**VME Rack**	• controls all handling operations • controls the optical functions • reads out, processes all image and control data • sends a raw image to the Processing Station
12	**Power Unit**	• supplies the required voltage for the different components • holds the main fuses • holds the line switch • holds the interlock switch (safety switch)
13	**Rotation Unit**	• turns the cassette units by 180° while the IP is scanned.

3 Functional Principle of Image Plate and Cassette

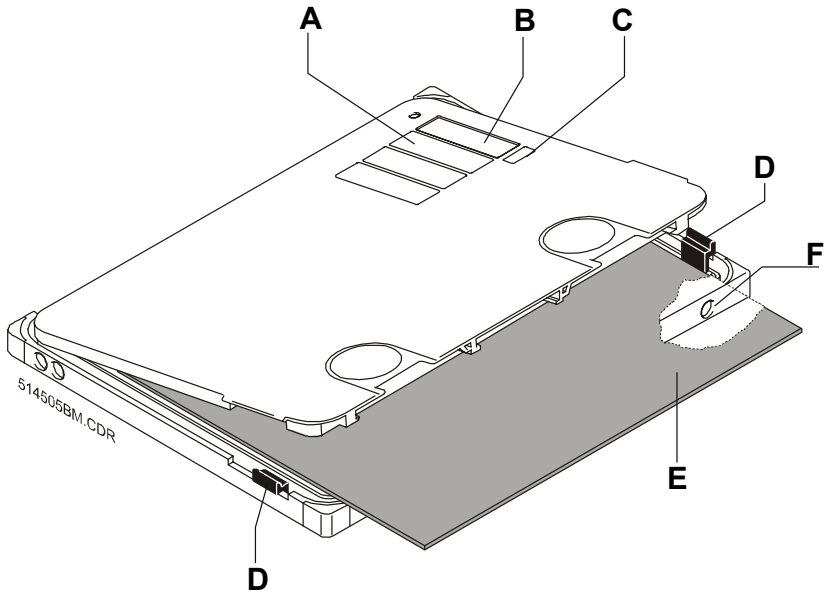


Figure 3

ADC cassettes are provided with:

- **A** ADC label
- **B** ID – Chip; carrier of the demographic data
- **C** label with size of Image Plate
- **D** sliders (left and right hand side); prevent ADC cassettes from being used in film handling devices)
- **E** ADC – Image Plate IP carrier of the diagnostic image (grey surface up, white surface down)
- **F** "silver dot", a metal label used by the digitizer to recognize ADC-cassettes

The digitizer only accepts ADC Compact/Solo cassettes. All other cassettes (e.g. ADC70 cassettes) are refused!
Always insert cassettes as shown in the picture below.

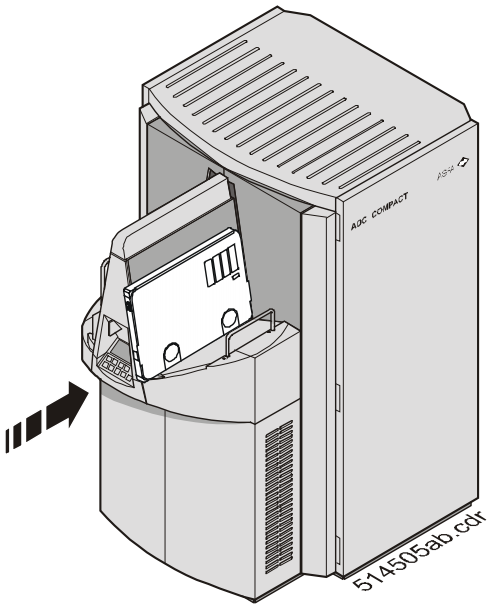


Figure 4

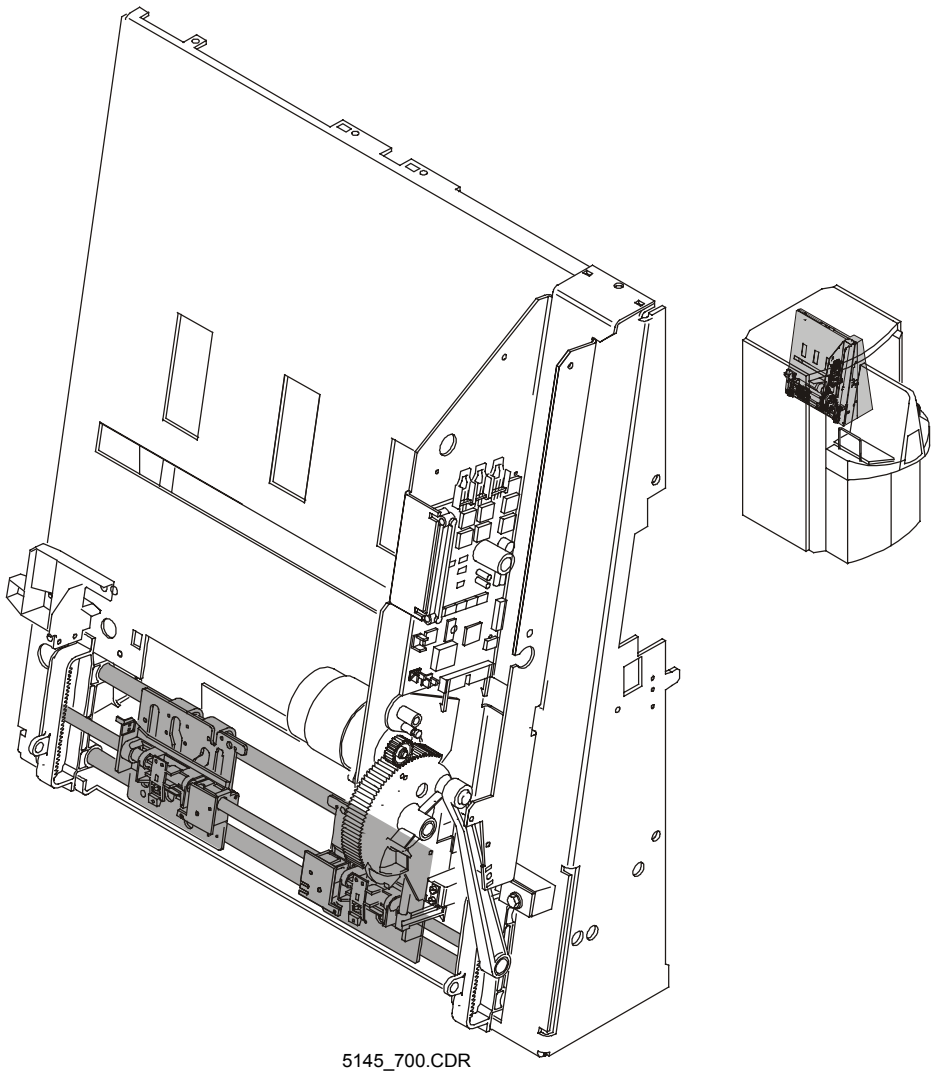
4 Main Components of the ADC Compact Digitizer

4.1 Cassette Unit 1/2

a) Components and Main Functions

- receives the cassette from the input buffer
- positions the cassette
- clamps and opens the cassette
- closes the cassette after the IP has been taken out

- opens the cassette before the cassette is brought back after scanning
- closes the cassette again
- transports the cassette to the output buffer



5145_700.CDR

Figure 5

4.2 IP-Transport Unit right (prescan)

a) Components and Main Functions

- takes the IP out of the cassette
- transports the IP down to the scan unit

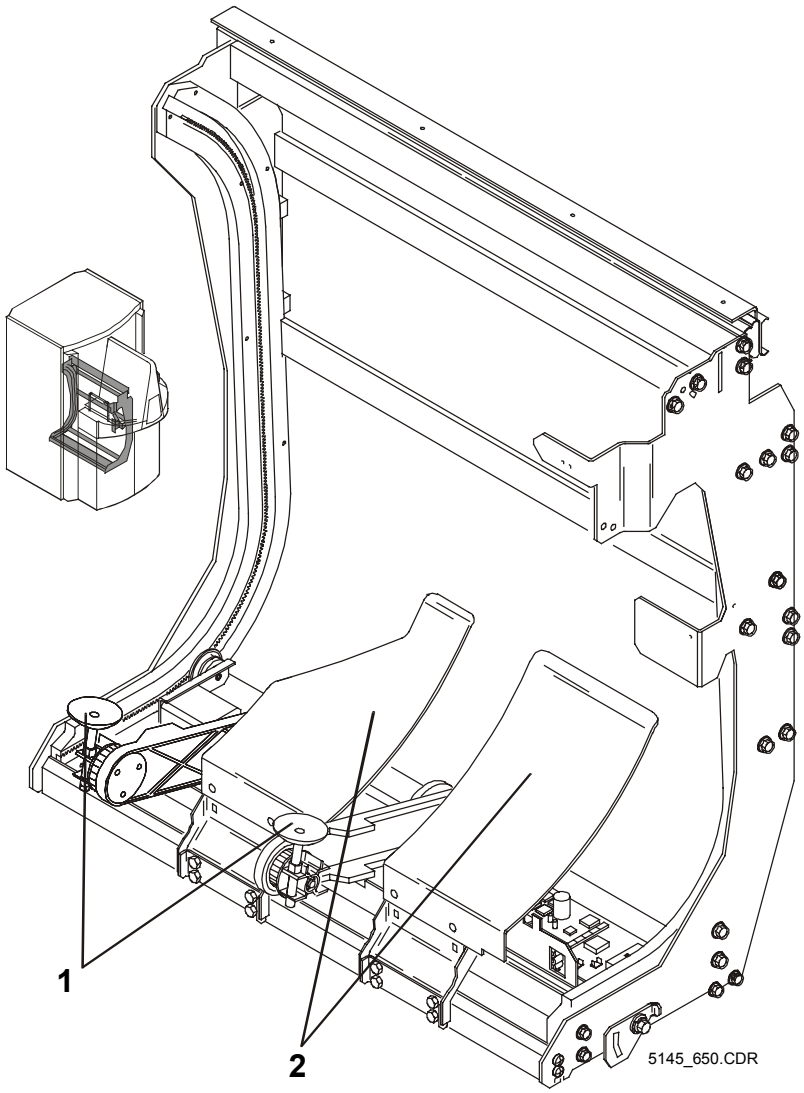


Figure 6

1. **Suction cups**
2. **Guide plate**

4.3 Scan Unit

Components and Main Functions

- a He-Ne laser (8) stimulates the phosphor ions of the image plate.
- scan rollers (4) guarantee a steady transport of the IP (slowscan)
- the galvo (2) is an oscillating mirror guiding the laser beam over the IP. It is controlled by a sweep signal generated in the Scan Acquisition Board.
- fibre optics (3) collect the emitted light and lead it to the photomultiplier tube (PMT) (1).
- the PMT takes exclusively the blue light (blue light filter)
- the PMT contains the I/V converter.

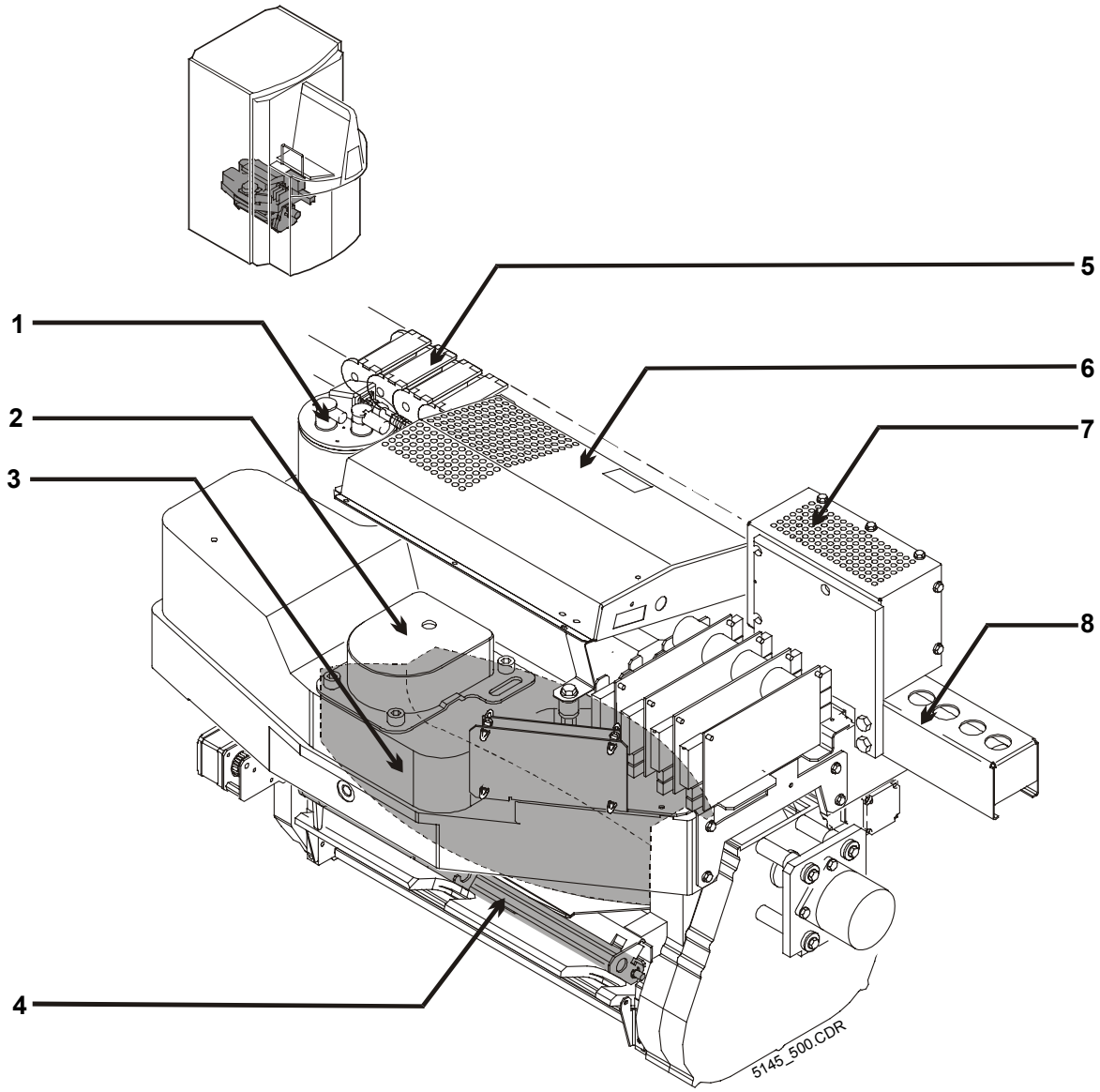


Figure 7

1	Photomultiplier	**5**	Energy Chain
2	Galvanometer	**6**	Galvo Driver Board
3	Fibre optics (2 x 6500 fibres)	**7**	HT - Box
4	Scan Rollers	**8**	He-Ne Laser

4.4 IP-Transport Unit (left)

Components and Main Functions

- takes the IP after scanning
- transports the IP back to the cassette.

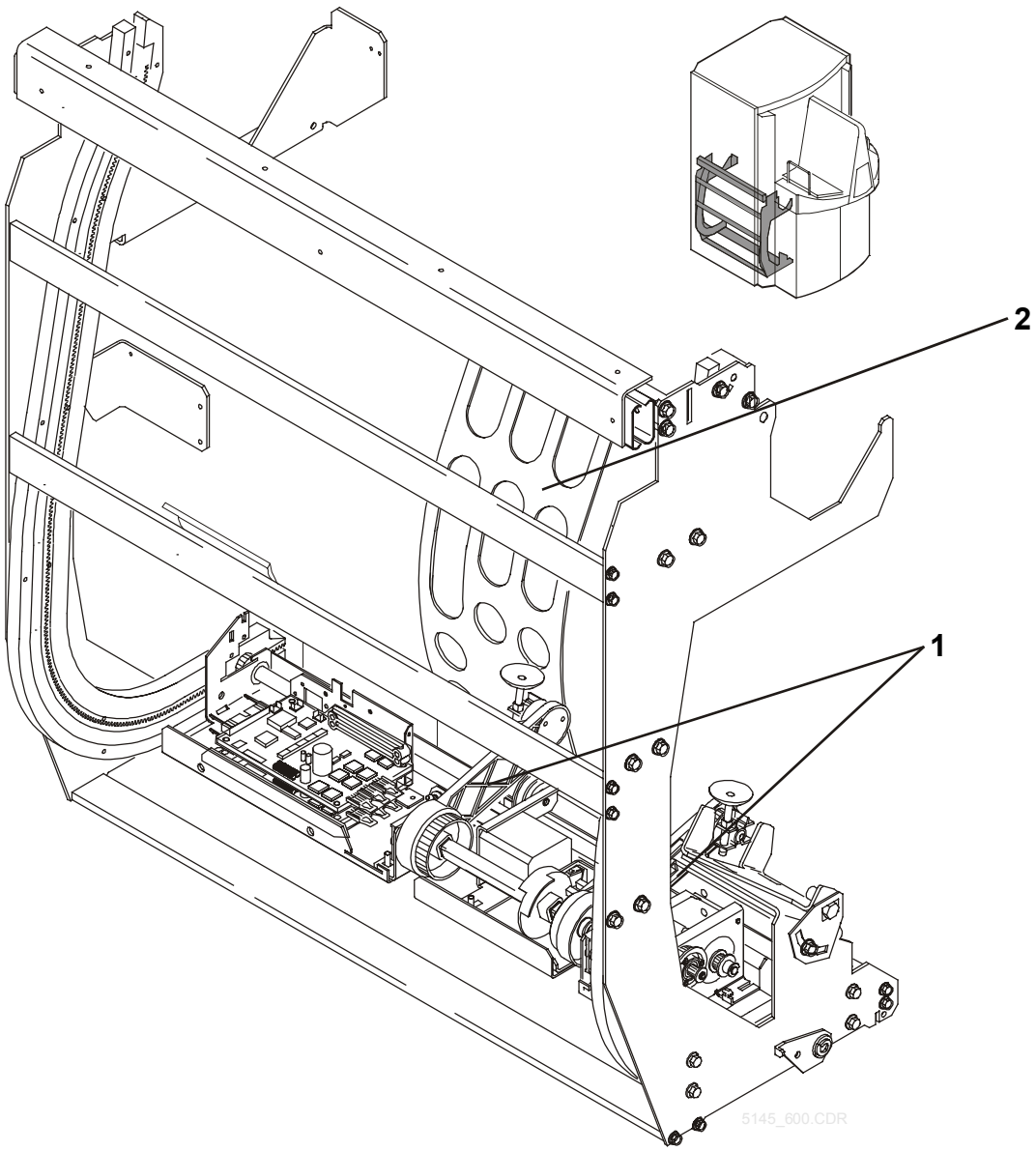


Figure 8

1. **Suction arms**
2. **Guide plate**

4.5 Erasure Unit (150)

Components and Main Functions

- erasing the IP. The erasure energy is determined by means of the ID-data (menu dependent). The erasure unit is cooled by a fan.
- the temperature of the erasure unit is monitored constantly. An overheat protection stops the digitizer in case of overheating.

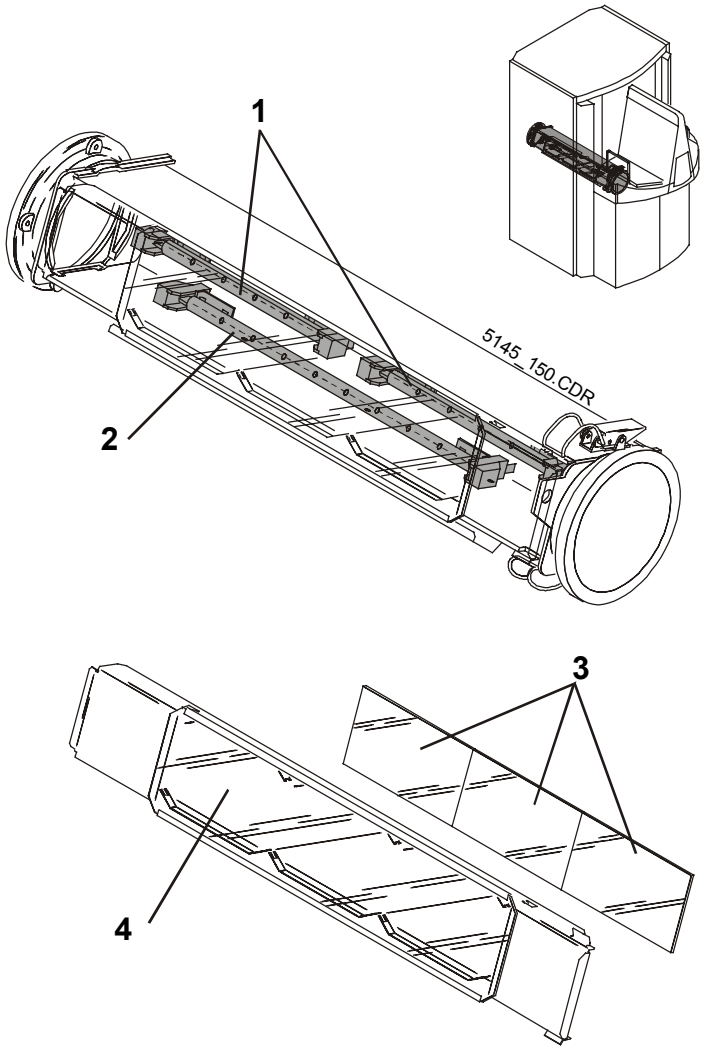


Figure 9

1 2 halogen lamps (1000 W each)

2 1 halogen lamp (2000 W)

3 KG2 –filter (heat protection)

4 front glass (UV-filter with sensitive gelatine layer)

4.6 VME-Rack (300)

Components and Main Functions

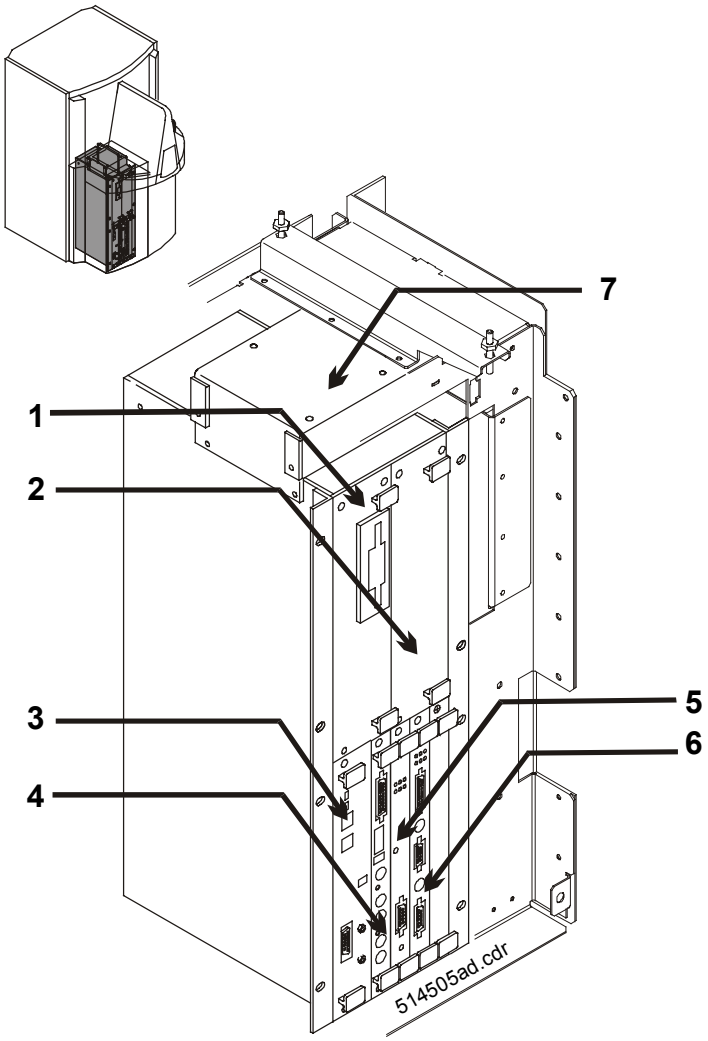


Figure 10

1 GS310 Storage Complete

2 GS320 Power Supply VME

3 GS330 CPU Gemini with BER- and Memory Board

4 GS340 SCB Board (Scan Control Board)

5 GS350 SAB Board (Scan Acquisition Board)

6 GS360 VME Adapter Board

7 Fan

Boards in the VME-Rack

Gemini Board / BER Board
Components and Main Functions

Gemini Board

- controls all the functions of the machine by dedicated driver boards.
- controls the scan process via Scan-Control-Board and Scan-Acquisition-Board.

BER-Board (**B**asic **E**thernet and **R**OCAN Interface)

- controls the internal hard disk.
- controls the floppy drive.
- drives the external Ethernet.
- drives the external serial port.

Front Panel Gemini / BER board

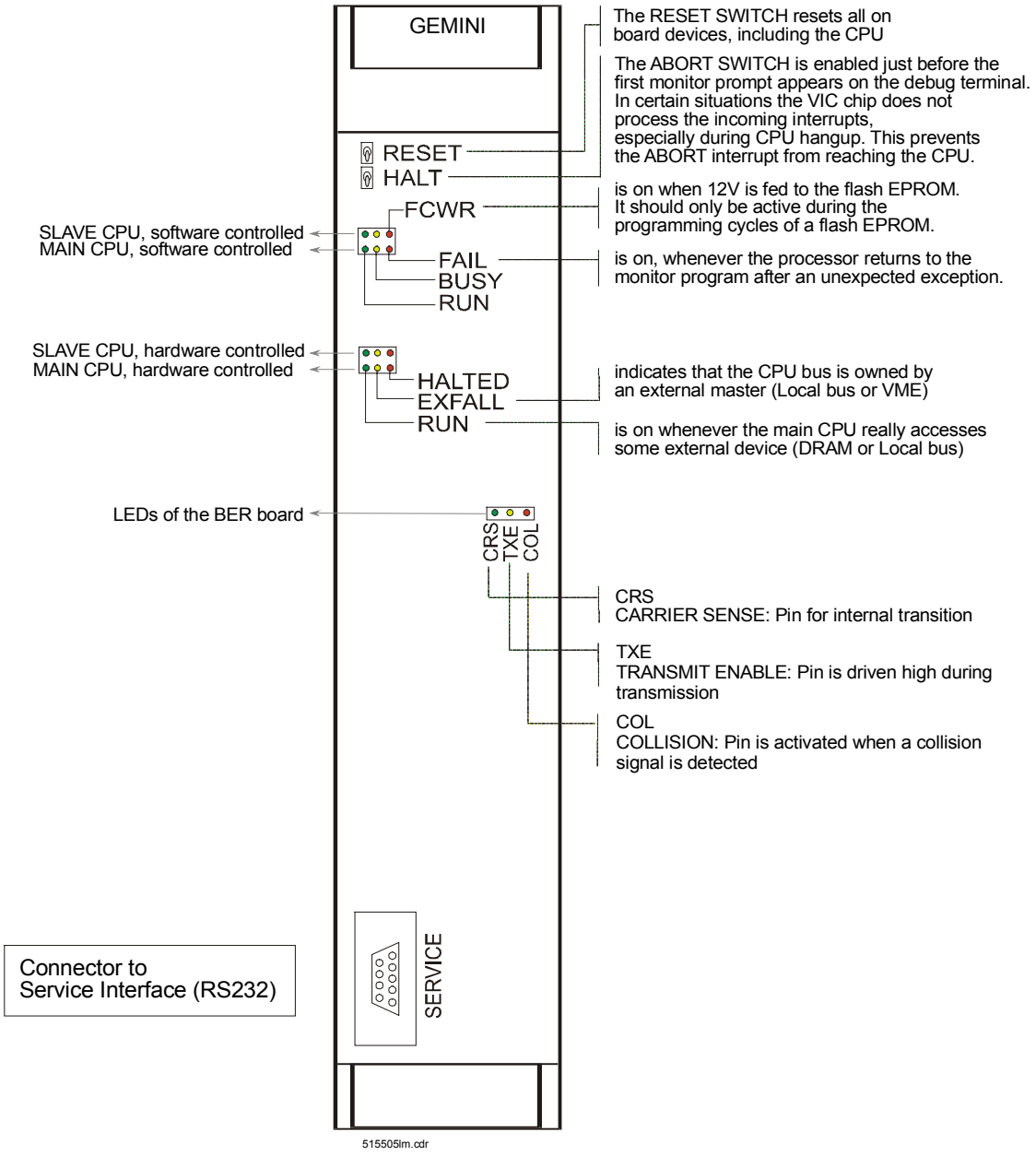

GEMINI
RESET
HALT
FCWR
SLAVE CPU, software controlled
MAIN CPU, software controlled
FAIL
BUSY
RUN
SLAVE CPU, hardware controlled
MAIN CPU, hardware controlled
HALTED
EXFALL
RUN
LEDs of the BER board
CRS
TXE
COL
SERVICE
Connector to
Service Interface (RS232)
The RESET SWITCH resets all on board devices, including the CPU
The ABORT SWITCH is enabled just before the first monitor prompt appears on the debug terminal. In certain situations the VIC chip does not process the incoming interrupts, especially during CPU hangup. This prevents the ABORT interrupt from reaching the CPU.
is on when 12V is fed to the flash EPROM. It should only be active during the programming cycles of a flash EPROM.
is on, whenever the processor returns to the monitor program after an unexpected exception.
indicates that the CPU bus is owned by an external master (Local bus or VME)
is on whenever the main CPU really accesses some external device (DRAM or Local bus)
CRS
CARRIER SENSE: Pin for internal transition
TXE
TRANSMIT ENABLE: Pin is driven high during transmission
COL
COLLISION: Pin is activated when a collision signal is detected
515505lm.cdr

Figure 11

VME-Adapter Board
Components and Main Functions

- adaptation to Ethernet.
- voltage supply (+24V) for the photomultiplier-HT-Box (**Hi**gh **T**ension).
- connection to the R/F-Tag reader and signal adaptation to RS232.
- connection to LCD terminal and conversion of the RS232 signal in a 20 mA signal.
- connection to the IO-Bus.

Front Panel Adapter Board

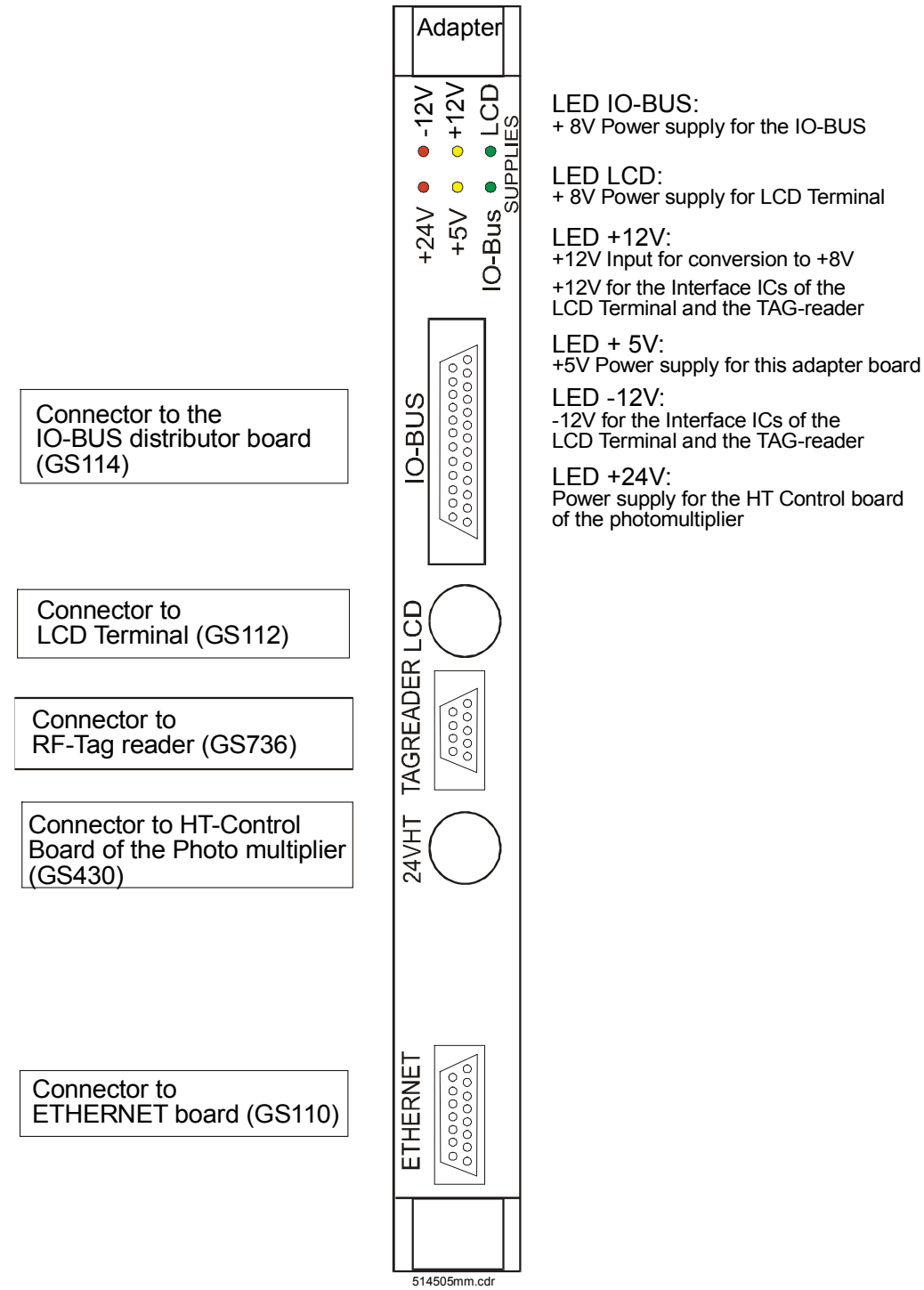


Figure 12

SAB Board (Scan Acquisition Board)

Components and Main Functions

- conversion of analog voltage to digital signal.
- compression and filtering the signals from the photomultiplier.

Front Panel SAB Board

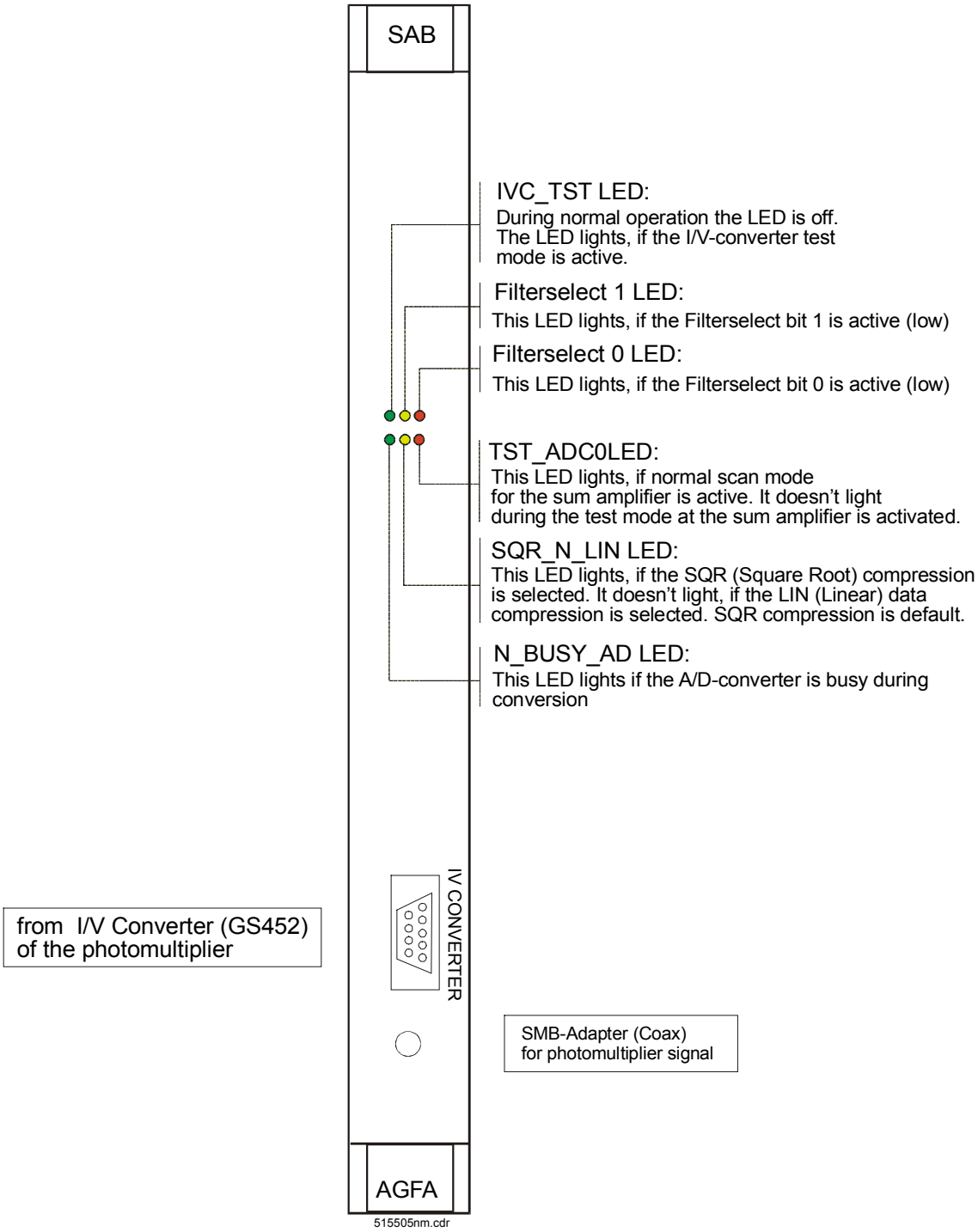

SAB
IVC_TST LED:
During normal operation the LED is off.
The LED lights, if the I/V-converter test mode is active.
Filterselect 1 LED:
This LED lights, if the Filterselect bit 1 is active (low)
Filterselect 0 LED:
This LED lights, if the Filterselect bit 0 is active (low)
TST_ADC0LED:
This LED lights, if normal scan mode for the sum amplifier is active. It doesn't light during the test mode at the sum amplifier is activated.
SQR_N_LIN LED:
This LED lights, if the SQR (Square Root) compression is selected. It doesn't light, if the LIN (Linear) data compression is selected. SQR compression is default.
N_BUSY_AD LED:
This LED lights if the A/D-converter is busy during conversion
IV CONVERTER
from I/V Converter (GS452) of the photomultiplier
SMB-Adapter (Coax) for photomultiplier signal
AGFA
515505nm.cdr

Figure 13

SCB-Board (Scan Control Board)

Components and Main Functions

- sweep amplitude and offset adjustment for the galvo.
- master clock signal (opto switch signal) controls the rotating shutter
- voltage adjustment for HT of the photomultiplier.
- adaptation of scan speed.

Front Panel SCB Board

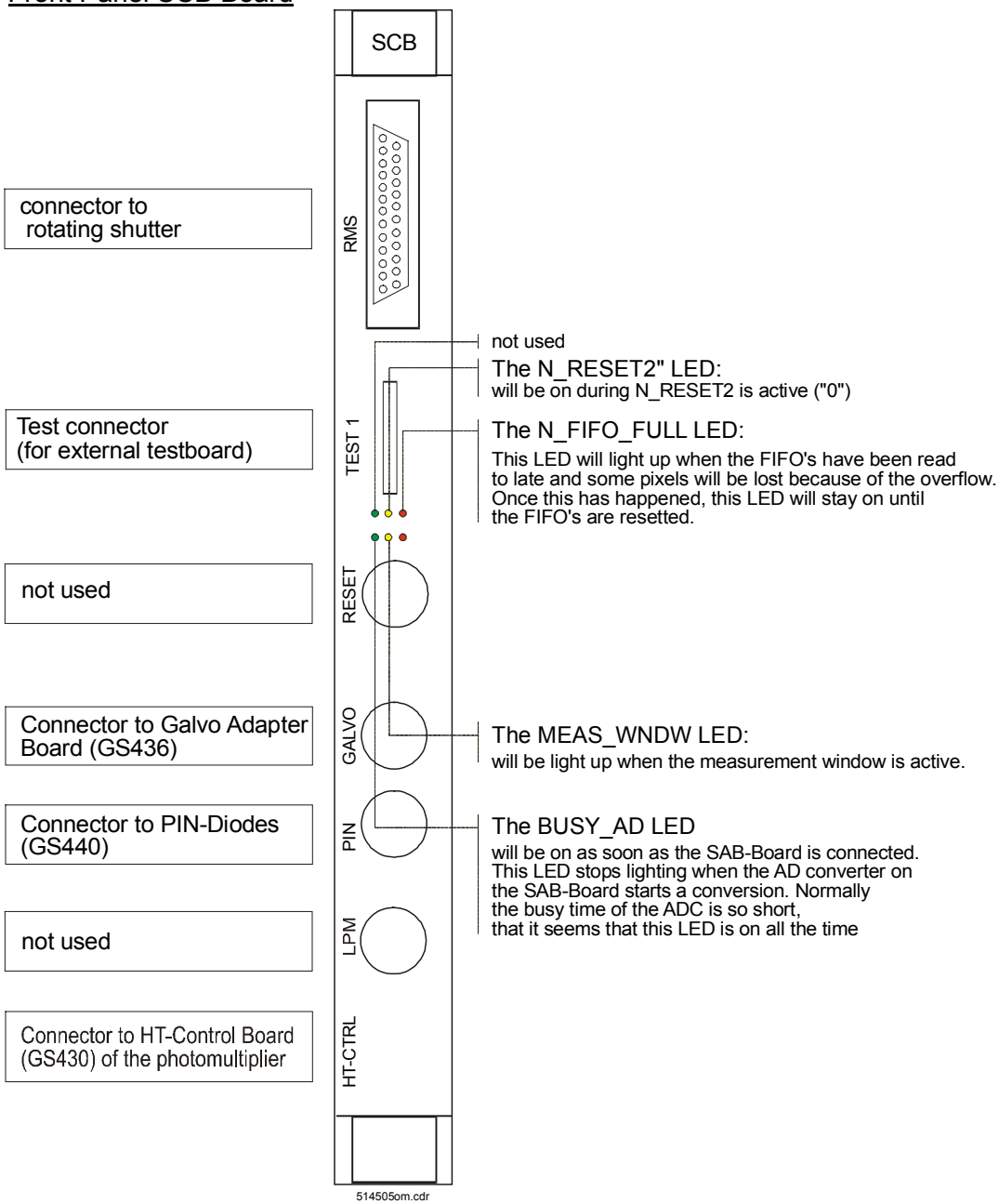

SCB
RMS
TEST 1
RESET
GALVO
PIN
LPM
HT-CTRL
connector to rotating shutter
Test connector (for external testboard)
not used
Connector to Galvo Adapter Board (GS436)
Connector to PIN-Diodes (GS440)
not used
Connector to HT-Control Board (GS430) of the photomultiplier
not used
The N_RESET2" LED:
will be on during N_RESET2 is active ("0")
The N_FIFO_FULL LED:
This LED will light up when the FIFO's have been read to late and some pixels will be lost because of the overflow. Once this has happened, this LED will stay on until the FIFO's are resetted.
The MEAS_WNDW LED:
will be light up when the measurement window is active.
The BUSY_AD LED
will be on as soon as the SAB-Board is connected. This LED stops lighting when the AD converter on the SAB-Board starts a conversion. Normally the busy time of the ADC is so short, that it seems that this LED is on all the time
514505om.cdr

Figure 14

The external testboard is used for troubleshooting to display following signals on an oscilloscope

- digital PIN-diodes signal
- A/D measurement window
- sweep signal.
- analog PIN-diodes signal

4.7 Power Unit

Components and Main Functions

Power supply for:
- erasure unit
- VME-rack
- step motors and SM boards

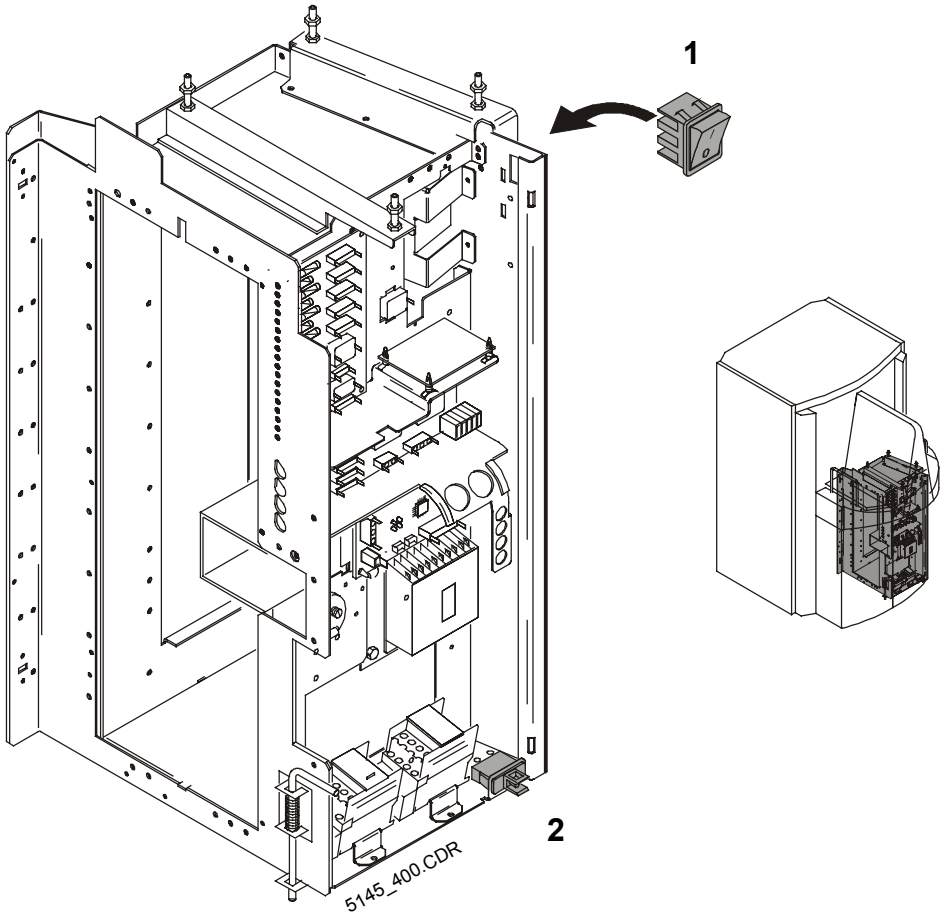


Figure 15

1 Main Switch

2 Interlock Switch (Safety Switch)

4.8 Rotation Unit (200)

Components and Main Functions

- transports the cassette without IP from input to output buffer by turning both cassette units by 180°.

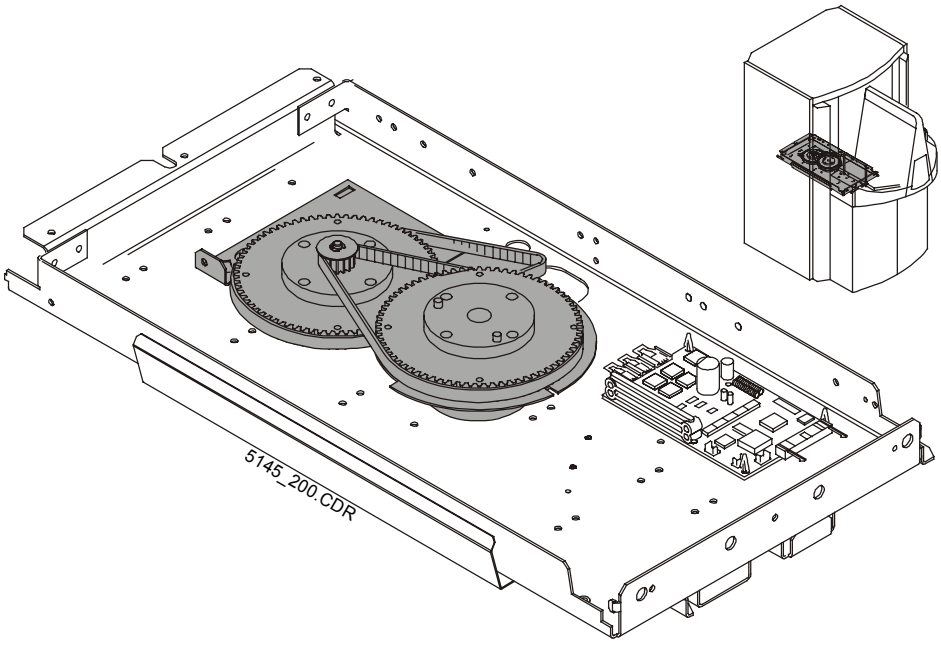


Figure 16

5 Machine Cycle

5.1 Cassette Input

- an ADC Compact/Solo Cassette is correctly set into the input buffer **(2)**.
- a light barrier monitors the cassette. Cassette is pulled in by the belt.
- GS940 recognizes the label (silver dot) at the bottom of the cassette **(2)**. The cassette is clamped.
- Label is recognized as ADC Compact/Solo Cassette, belt stops and the cassette moves a fixed number of steps. Then the chip of the cassette is read.
- the RF-tag reader reads the ID-chip on the cassette.

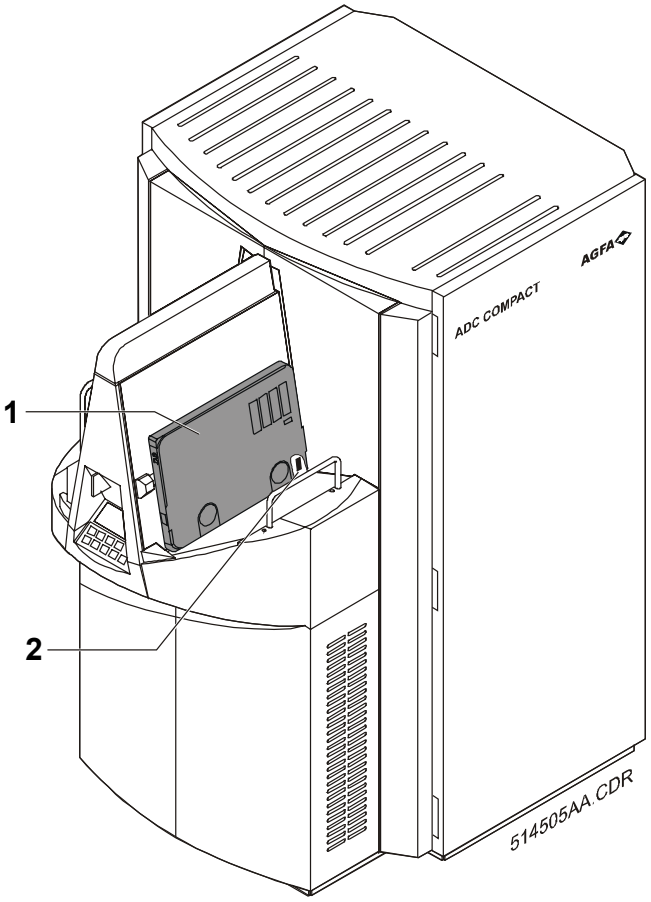


Figure 17

5.2 Clamping the Cassette

- the roller pulls the cassette in **(1)**.
- light barrier (LS716 long distance) **(2)** monitors the transport.
- cassette is lowered and clamped
- a light barrier **(3**) monitors clamping and opening

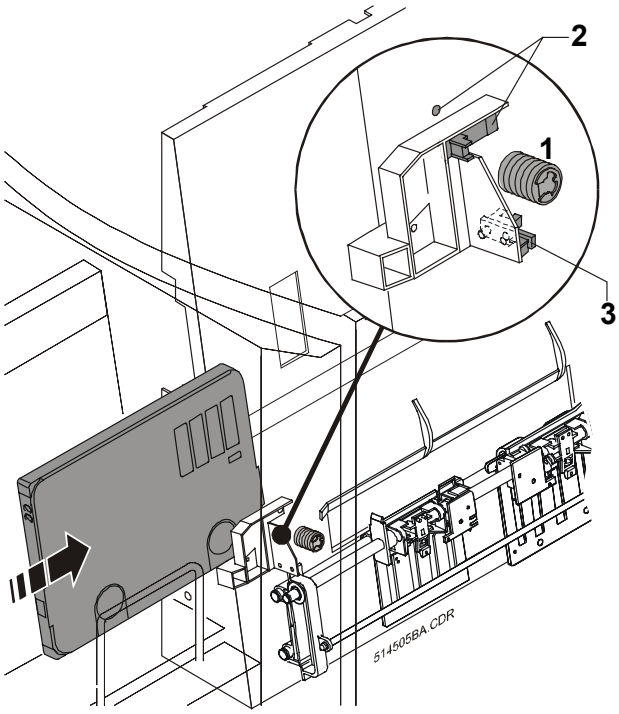


Figure 18

5.3 Opening the Cassette

- cassette is opened **(1)**.
- IP-transport (prescan) moves suction arms to start position.
- vacuum pump **(2)** is started.

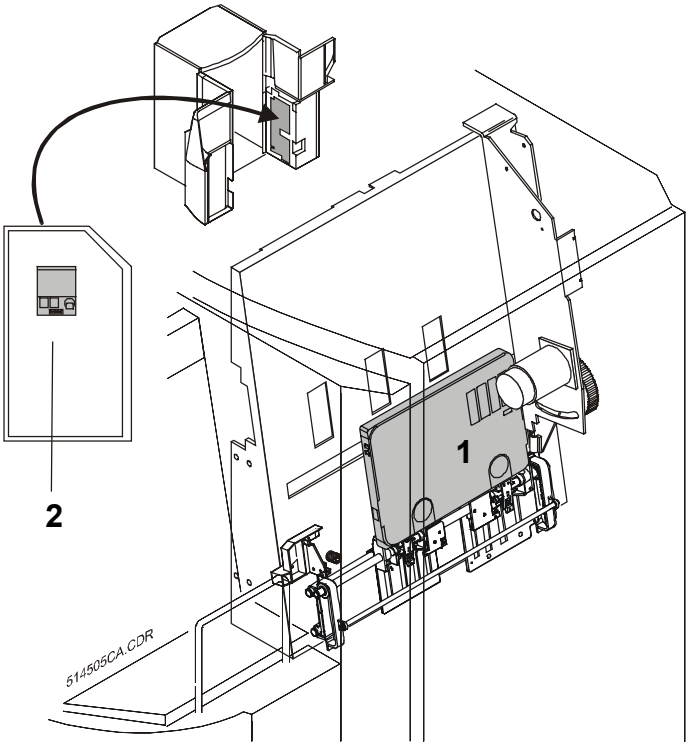


Figure 19

5.4 Sucking the IP

- suction cups move close to the IP **(1)**.
- magnetic valve is opened.
- vacuum is transmitted to the suction cups.
- IP is sucked **(2)**.

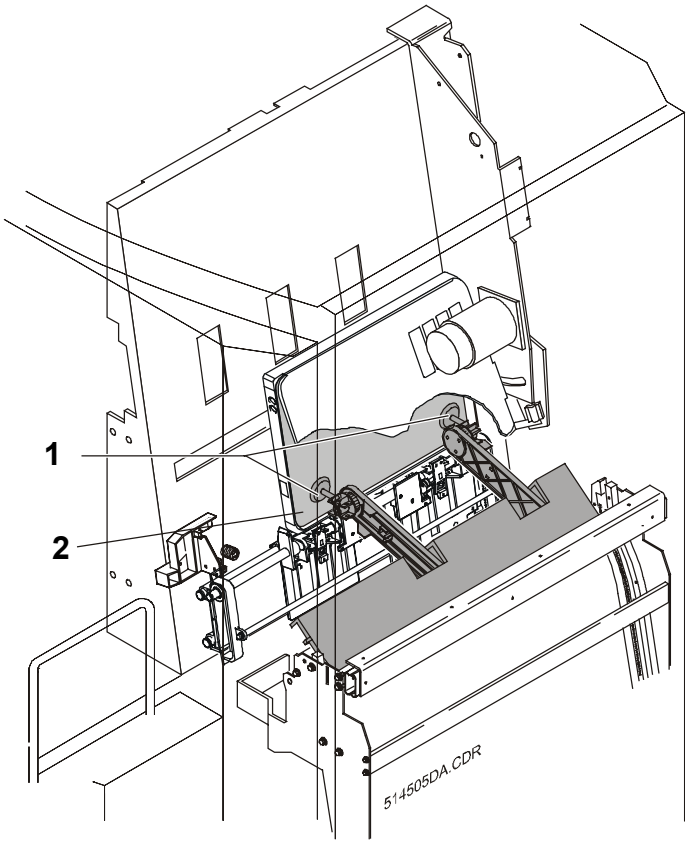


Figure 20

5.5 Taking the IP out of the Cassette and down to the Scan Unit

- IP-transport (prescan) takes the IP down to the guide plate.
- scan rollers start and move apart **(1)**.
- vacuum pump stops and vacuum is reduced.
- suction arms let the IP go off **(2)** and move away.
- the guide plates lead the IP to the scan unit

While the IP is taken out of the cassette the scan unit is prepared for scanning.

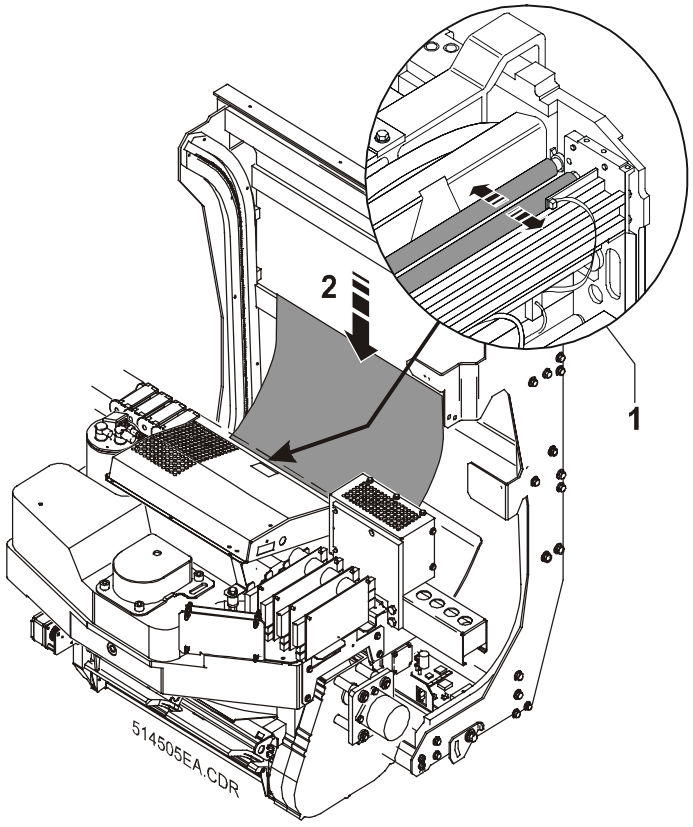


Figure 21

5.6 Rotating the Cassette Units by 180°

- after the IP has been taken out the rotation unit turns by 180° **(1)**.
- cassette is closed.
- when rotation is finished the cassette opens again to be ready to receive the erased IP
- light barrier GS114 **(2)** monitors the position of the cassette units.

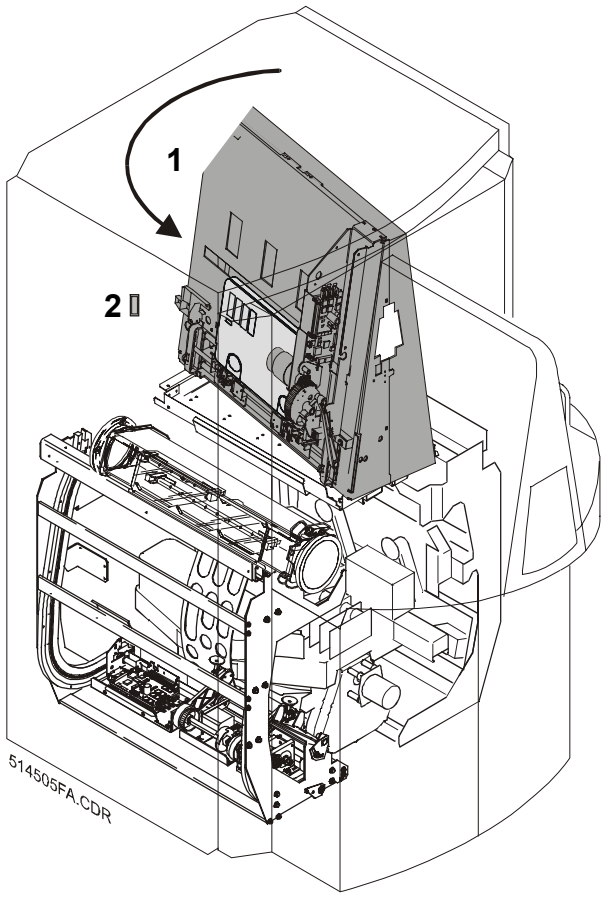


Figure 22

5.7 Loading the IP in the Scan Unit

- the IP-alignment (prescan) centers the IP exactly at the scan unit.
- scan rollers **(1)** clamp the IP and pull it inside the scan unit at a constant speed **(2)**.
- the IP interrupts the pin diodes (begin of scan).
- IP-transport moves back to start position.

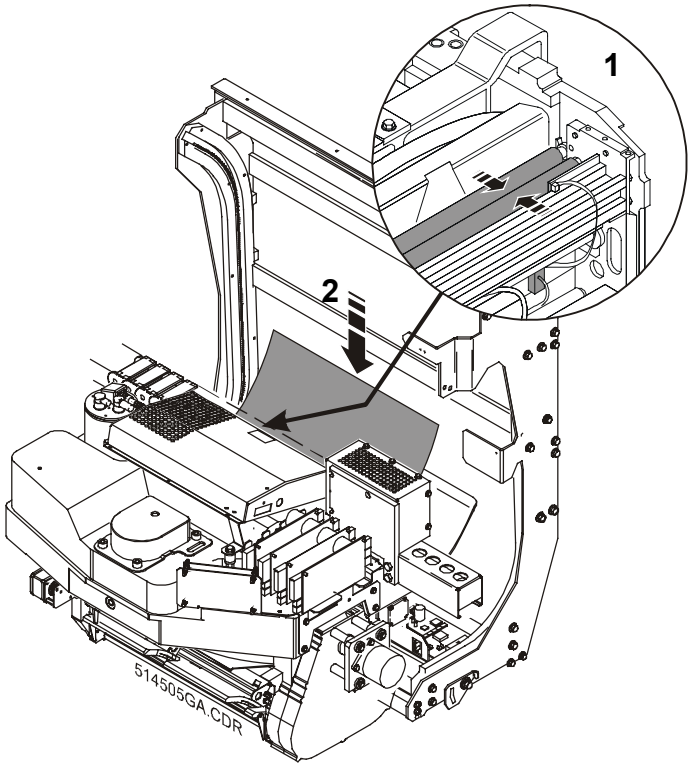


Figure 23

5.8 Scanning the IP

- the laser scans the IP line by line. (“fast scan”).

A Laser beam
B Image Plate

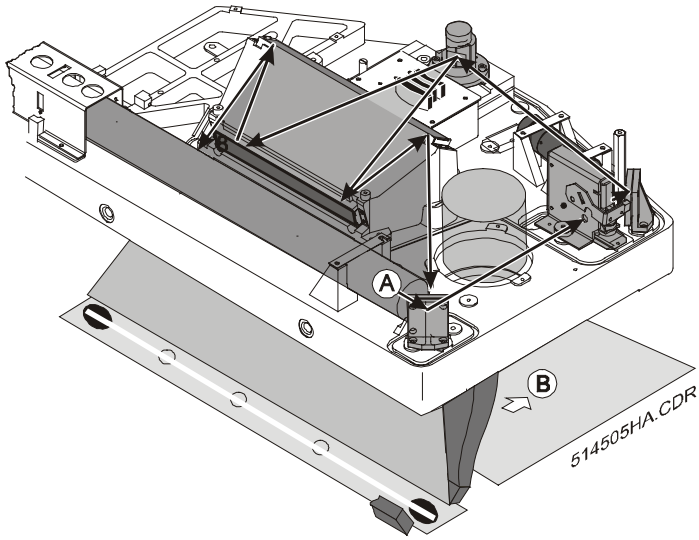
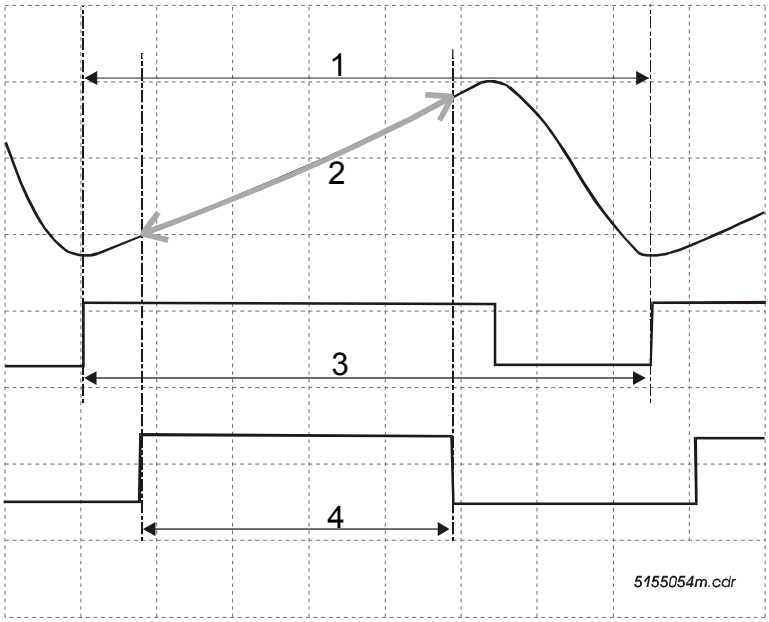


Figure 24

The function of the scan unit is described in detail in chapter 6 of this section.

5.9 Stimulate and Scan the IP

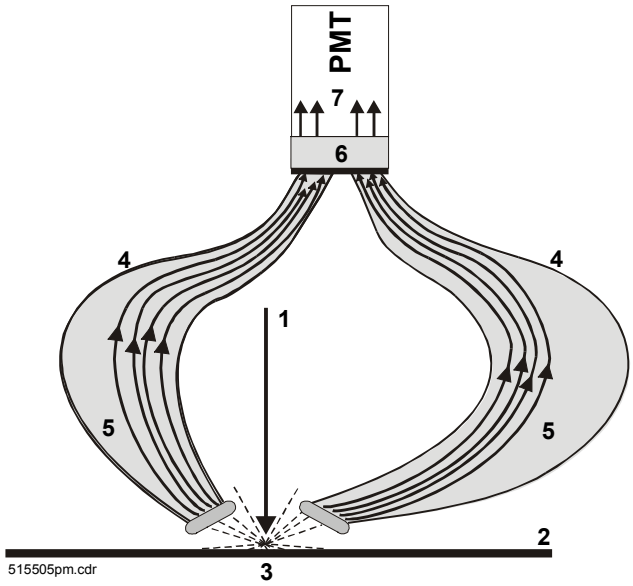
- sweep signal **(1)**
  control signal for the galvo;
  generated in the SCB board.
- period of constant laser speed **(2)**.
- signal controlling the laser beam **(3)** (opto-switch signal = trigger signal).
- signal **(1)** and **(3)** are synchronized in the SCB - board.
- A / D window **(4)**
  time period when the image is actually digitized.



An oscilloscope can show the signals via an external test board (connected to SCB-board).

5.10 Collecting the Light

- laser beam **(1)** (red light) stimulates the IP **(2)**.
- light is emitted to all directions **(3)**.
- fiber optics **(4)**, 2x 6500 fibers.
- light **(5)** guided through the fiber optics.
- filter **(6)** allows only blue light to pass.
- only blue light **(7)** is taken to the PMT and converted into current.



5.11 Unloading the IP from the Scan Unit

- IP leaves the scan unit and falls down on the postscan bar **(1)**.
- light barrier (GS548) is interrupted and recognizes the presence of an IP (this light barrier is only used to increase the throughput; actually the procedure is time-programmed.)
- the IP is positioned relative to the cassette (postscan alignment).
- the IP transport (postscan) moves to start position.

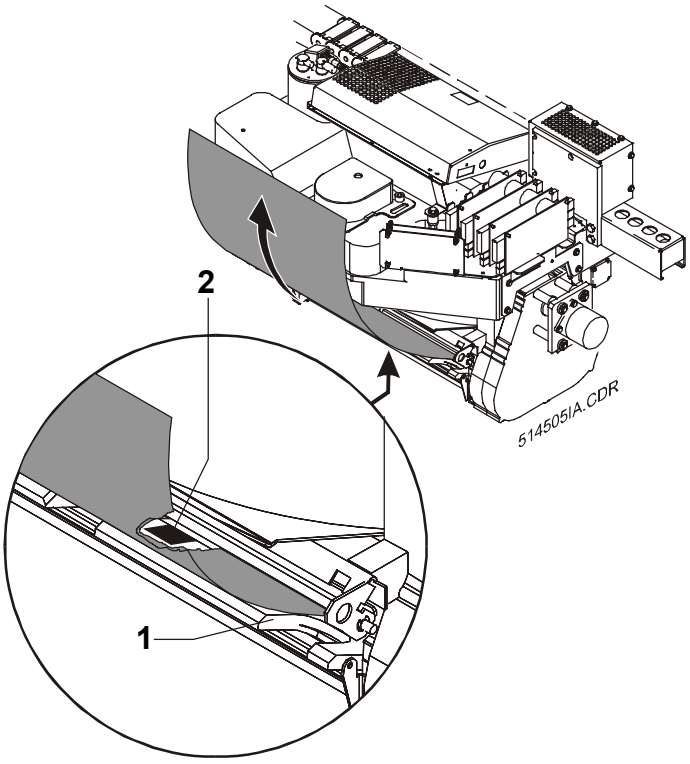


Figure 25

5.12 Moving the IP upwards / Erasing the IP

- vacuum pump starts.
- suction cups suck the IP.
- IP-transport unit takes the IP and moves to the start position for erasing (format dependent) **(1)**.
- system checks if erasure unit is ready for operation:

  - if temperature < 85 °C: erasure unit starts.
  - if temperature > 85 °C: start of erasure unit is delayed until temperature has dropped below 75 °C (cooling delay).
- the IP-transport passes the erasure unit at a fixed speed and IP is erased **(2)**.

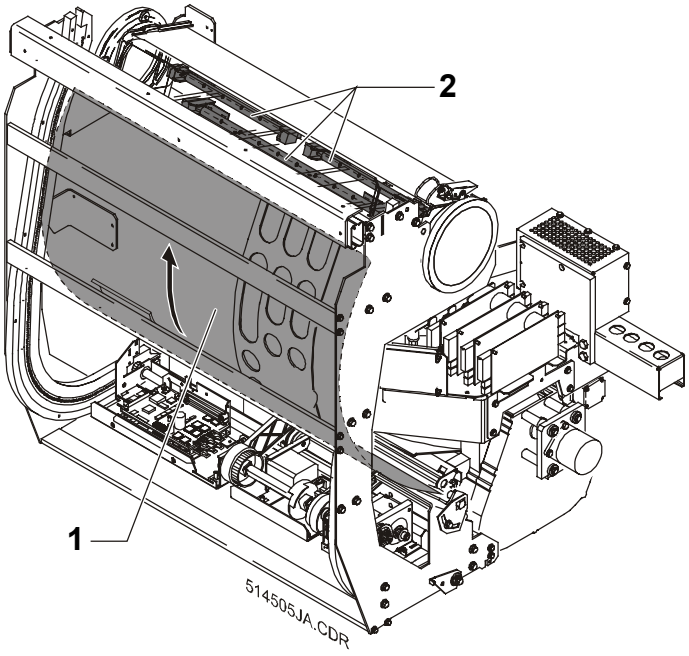


Figure 26

The erasure depth depends on how long the IP is in front of the erasure unit.

5.13 Putting the IP back into the Cassette

- the IP-transport puts the IP back into the cassette.
- vacuum pump stops and vacuum is reduced
- IP-transport unit moves back and down simultaneously and returns to home position.
- cassette is closed and unclamped.
- output buffer is made ready for operation.

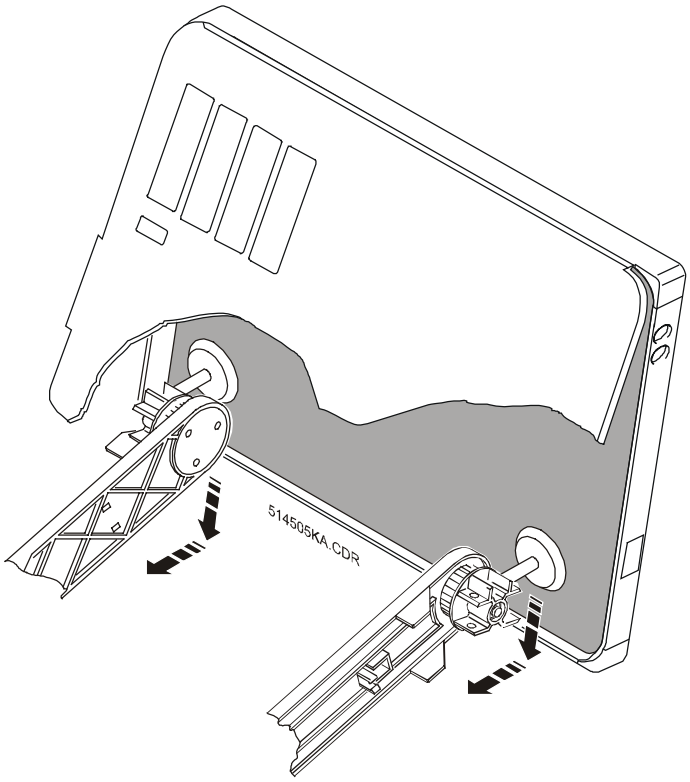


Figure 29

5.14 Cassette Output

- rollers and belts **(1)** transport the cassette out of the digitizer.
- a light barrier at the output buffer rollers recognizes the end of the transport.

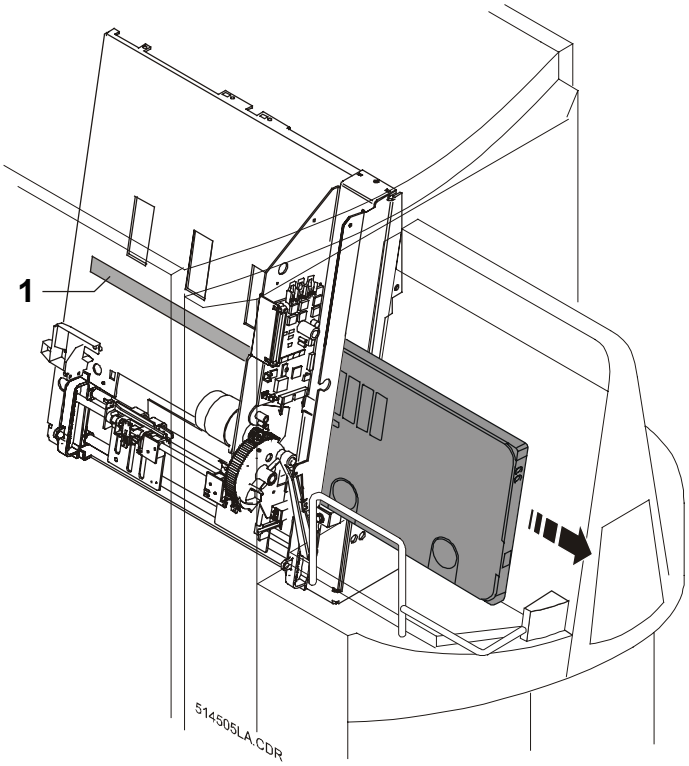


Figure 30

5.15 Output Buffer

- lever of the output buffer (1) pushes the cassette aside.
- cassette is ready to be used again.

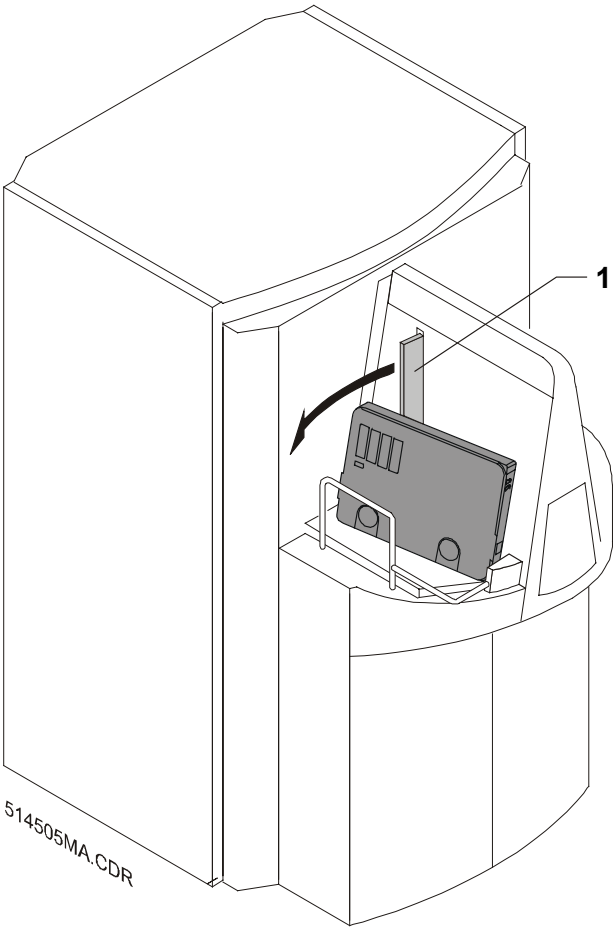
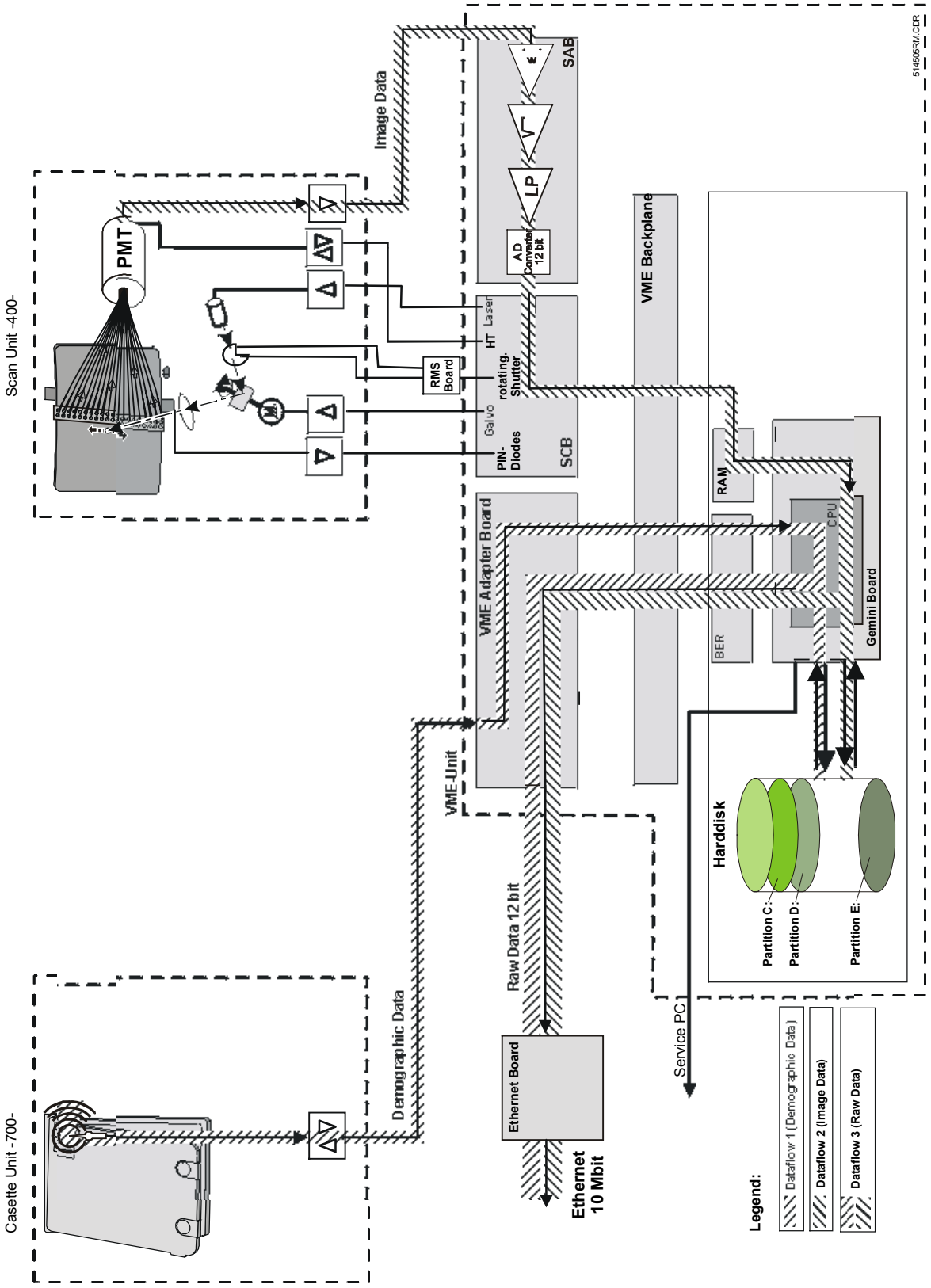


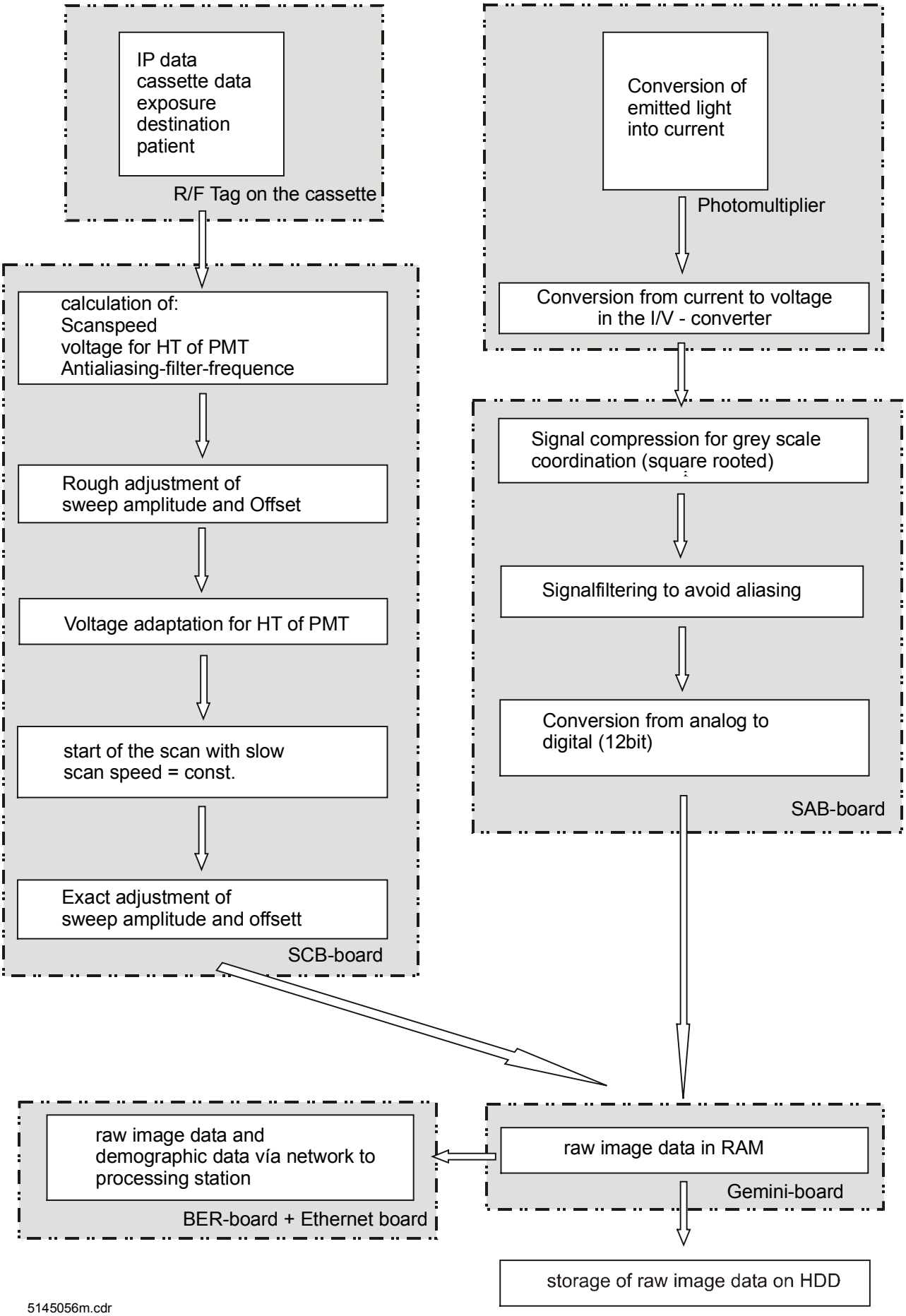
Figure 31

7 Signal- and Data Flow

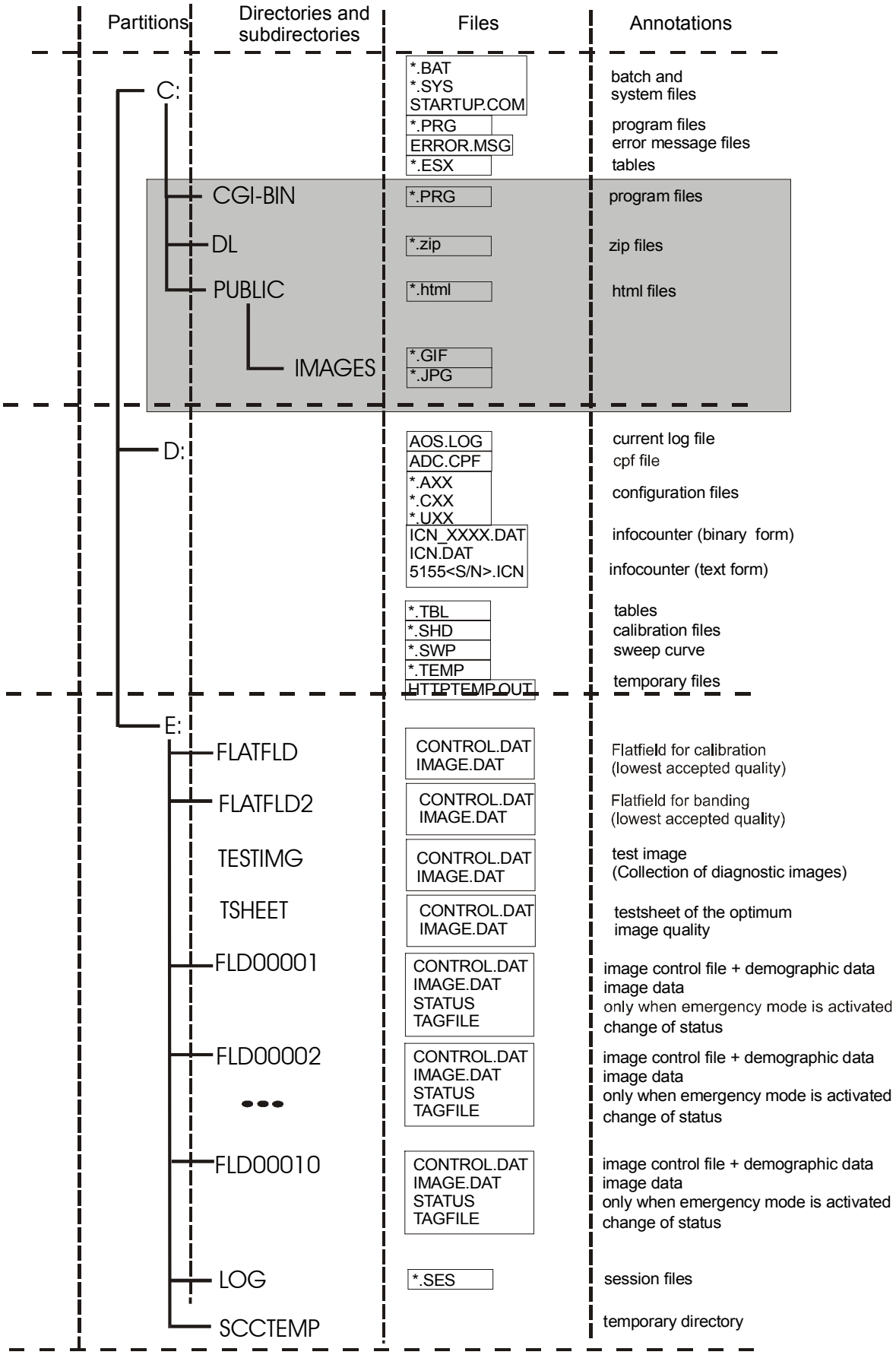
7.1 Signal Flow



7.2 Image and Control Data Flow



7.3 Partition Map of the Hard Disk



Annotations:

The gray rectangle marks the directories which are only necessary for remote control via http access.

A CD-ROM containing the test images can be ordered: CM+9.5145.1055.0

The E – partition must not be formatted; otherwise all test images would be lost. To avoid any formatting, the 'format' program is delivered no longer.

The complete hard disk will be formatted and partitioned when the hard disc formatter floppy (boot floppy) is used.

7.4 FLDXXXXX-directories:

CONTROL.DAT (Image control file)**:**

There are six possibilities of the status in an image control file:

queued *:	waiting for transmission
sending:	transmission in progress
sent:	transmission completed, waiting for response
transmitted:	positive response from workstation
warning *:	positive response, but file cannot be handled from workstation at the moment => new transmission
error *:	faulty file, transmission cancelled

Note:

Only images being in the status marked with a "*" can be deleted via operation terminal.
Nevertheless, you can delete any folder from the E-partition manually.

TAGFILE

File date and time when the status is changed.

7.5 NVE-List

The following table is just for information purposes – there is absolutely no part in it which is user configurable. One part of the data is set by configuring the device with the CPF file, the other part is maintained internally.
Unlike the MG3000 (where there is no hardware), any modification to these NVFs can cause severe damages to the hardware!

Task	Instances	Description
ARTXXX00	0..23	Apip Routine Table – stores hostname, IP address and port of known destinations
SYSXXX00	0..0	SYStem Starter – defines all the components to be started
RTTXXX00	0..0	Remote Target Table – holds information about subnetmask and defaultrouter
ETSXXX00	0..0	EThernet Server – definition of network servers to be started
NETXXX00	0..0	TCP/IP Stack – definition of table sizes
ICNXXX00	0..0	Info CouNters – location of files
CGIXXX00	0..0	CGI communication server – starts HTTP server
COCXXX00	0..0	COmpact Control – keeps track of the device status
UIFXXX00	0..0	User InterFace – communication properties
DSKXXX00	0..0	DiSK – auxiliary functions to handle the floppy – defines patterns to datafiles to be saved as backup
CPFXXX00	0..0	CPF parser – the location of the CPF is stored here
IOCXXX00	0..0	IObus Controller – Configuration data related to IOBUS components
CASXXX00	0..1	CASsette Data Translator – Definition of the demographic data used with the EMERGENCY buttons
DCMXXX00	0..0	DiCoM driver – DICOM configuration
BACXXX00	0..0	Buffer ACquisition – all configuration data related to the internal spooler
MIFXXX00	0..0	MIFare Tagreader – tagreader configuration
SCNXXX00	0..0	SCaNner – Scanner parameters
FIPXXX00	0..19	Format IP – table to store IP parameters
SSCXXX00	0..0	SlowSCan – parameters of the slowscan driver
SCCXXX00	0..0	SCanner Calibration – parameters related to the scanner calibration
HDCXXX00	0..0	HanDling Control – current status of the handling
CAMXXX00	0..1	CAssette Modules – positions, timeouts, ...
TPRXXX00	0..0	TransPort pRescan – Roboter Prescan
TPOXXX00	0..0	TransPort pOstscan – Roboter Postscan
GODXXX00	0..0	GOoDies Starter – specification of helper components to be started
DRAXXX00	0..0	DRAwing Unit – converts curves into images, image properties
REDXXX00	0..0	REDirector – keeps track of destination status and transmission properties (enabled/disabled, rerouting)
QUEXXX00	0..0	QUEue Viewer – Spooler Queue Viewer, no configurable data
TIGXXX00	0..0	Test ImaGe Launcher – initiates the sending of the testimages
ROTXXX00	0..0	ROTor
IBFXXX00	0..0	InputBuFfer
OBFXXX00	0..0	OutputBuFfer
PCFXXX00	0..0	PreCheck Filter
PCDXXX00	0..0	PreCheck Driver